Preliminary Stormwater Management Report

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ACRONYMS

ADT	Average Daily Traffic
AKART	All Known, Available, and Reasonable Technology
API	American Petroleum Institute
BMP	Best Management Practice
BRT	Bus Rapid Transit
CADD	Computer-Aided Drafting and Design
cf/ac	Cubic Feet per Acre
DCLU	Department of Construction and Land Use (Seattle)
ESA	Endangered Species Act
HM	Hydraulics Manual (WSDOT)
HOV	High-Occupancy Vehicle
HRM	Highway Runoff Manual (WSDOT)
HSPF	Hydrologic Simulation Program-Fortran
I-5	Interstate 5
IL	Instructional Letter
KCRTS	King County Runoff Time Series
KCSWDM	King County Surface Water Design Manual
LID	Low-Impact Development
NPDES	National Pollution Discharge Elimination System
SBUH	Santa Barbara Urban Hydrograph
SCS	Soil Conservation Service
SR	State Route
SWMMPSB	Stormwater Management Manual for the Puget Sound Basin (WSDOE)
SWMMWW	Stormwater Management Manual for Western Washington (WSDOE)
TSS	Total Suspended Solids
WSDOE	Washington State Department of Ecology
WSDOT	Washington State Department of Transportation
WWHM	Western Washington Hydrology Manual

1. INTRODUCTION

This Stormwater Management Report is being submitted to The Washington State Department of Transportation (WSDOT) for review and comment to satisfy a portion of Task 8.4.1 of Supplement 11 Work Order 6 for the State Route (SR) 520 Trans-Lake Washington Project. The project area is located on Interstate 5 (I-5) in Seattle between Stewart Street and the Ship Canal Bridge and on SR 520 between the I-5 interchange and Union Hill Road in Redmond. This report presents expected WSDOT stormwater treatment and detention requirements and conceptual drainage stormwater facility locations for the project area.

1.1 DESCRIPTION OF ALTERNATIVES

Depending on the alternative selected, up to 2 miles of I-5 and approximately 13.8 miles of SR 520 are proposed for geometric and/or capacity improvements. The three alternatives being considered would add varying amounts of impervious pavement in multiple drainage basins, requiring that additional stormwater facilities be installed to treat and control runoff to meet current regulations. For the three alternatives described below, different degrees of stormwater conveyance, water quality, and detention facilities are proposed at select locations.

1.1.1 4-Lane Alternative

This alternative would reconstruct SR 520 extending from I-5 on the west, to 108th and Bellevue Way on the east; however, it would make no major capacity improvements to SR 520. Bridges on SR 520 (including Portage Bay Viaduct, Evergreen Point Floating Bridge, and Lake Washington Boulevard) would also be replaced. The entire roadway would be reconstructed to full design standards, which would include inside and outside shoulders. Construction requirements would also involve realigning the facility to the north at Portage Bay and across Lake Washington. A 12-foot bicycle and pedestrian path would be provided along SR 520 between Lake Washington Boulevard in Seattle and 84th Avenue NE in Medina. Minimal improvements to I-5 are included in this alternative. The Montlake interchange will be reconstructed and include a transit flyer stop. The Lake Washington Boulevard interchange will be reconstructed, providing the same functional connections that exist today. Undercrossings at Evergreen Point Road, 84th Avenue NE, and 92nd Avenue NE will be replaced.

1.1.2 6-Lane Alternative

This alternative would construct a continuous high-occupancy vehicle (HOV) and bus rapid transit (BRT) lane and two general purpose lanes on SR 520 in each direction from I-5 in Seattle to Union Hill Road in Redmond, for a minimum of six lanes. Auxiliary lanes would be added near several interchanges. The Portage Bay Viaduct and floating bridge would be replaced. This alternative also assumes full design standards the length of the corridor. A 12-foot bicycle and pedestrian path will be provided on the north side of the new facility connecting to existing pathways on each side of the lake. Several segments in the corridor could be lidded, and other segments could have noise walls, but the extent of these have not been determined. In addition, SR 520 HOV and general purpose lanes would connect to I-5 lanes to the south and north, with northbound and southbound ramps at Mercer Street, and the southbound off-ramp to Stewart Street will be modified.

On the west side, the following SR 520 interchanges would be modified to accommodate the widening: *Montlake Boulevard and Lake Washington Boulevard***.**

On the east side, the following SR 520 interchanges would also be modified to accommodate the widening: *84th Avenue NE; 92nd Avenue NE; Bellevue Way NE and Lake Washington Boulevard NE; 108th Avenue NE; I-405; 124th Avenue NE; 148th Avenue NE; West Lake Sammamish Parkway NE; and Redmond Way/SR 202.*

1.1.3 8-Lane Alternative

This alternative is similar to the 6-lane alternative except it would provide a continuous HOV/BRT lane and three general purpose lanes in each direction between I-5 and Redmond Way/SR 202 in Redmond with HOV lanes to Union Hill Road. Most interchanges also would be similar to those in the 6-lane alternative,; one exception is that the interchanges would be larger to accommodate the wider roadway, with the following differences: improvements to Lake Washington Boulevard would include a tunnel crossing the Montlake cut and NE 40th Street and NE 51st Street would be reconstructed to accommodate a median flyer stop in addition to the widening.

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2. STORMWATER DESIGN REQUIREMENTS

2.1 GENERAL

Since I-5 and SR 520 are state highways, WSDOT-adopted drainage design criteria would apply to design of stormwater facilities for most improvements. Conveyance systems or other drainage facilities on City streets designed to local standards would be exceptions.

2.2 DESIGN REFERENCES

Table 2.1 lists the local jurisdictions for which the project is located and the current stormwater design references being used:

Table 2.1 Current Stormwater Design References in Project Area

Jurisdiction	Current Stormwater Design References
WSDOT	Highway Runoff Manual (HRM), 1995 Hydraulics Manual (HM),1997 Stormwater Instructional Letter (IL) 4020.02 Stormwater Management Manual for Western Washington (SWMMWW), 2001
Seattle	Stormwater, Grading, and Drainage Control Code, Volumes 1 through 4 (July 2000)
Medina	Medina Stormwater Ordinance,1987
Clyde Hill	King County Surface Water Design Manual (KCSWDM), 1979
Hunts Point	Stormwater Management Manual for the Puget Sound Basin (SWMMPSB),1992
Kirkland	KCSWDM ,1998
Bellevue	SWMMPSB,1992 Drainage Master Plan, 1976
Redmond	SWMMPSB,1992 City of Redmond Technical Notebook,1999 Bear Creek Basin Plan

2.2.1 Hydraulics Manual (1997)

The WSDOT Hydraulics Manual provides general policy guidance on hydrology and hydraulics that will be used when detailed design of drainage facilities is performed. The manual will be used as the primary reference for hydraulic report preparation, stormwater conveyance design, and material selection for various drainage structures that will be owned and maintained by WSDOT.

2.2.2 HRM (1995)

As part of the Puget Sound Water Quality Plan and the Puget Sound Highway Runoff Program, the HRM contains WSDOT's stormwater management minimum requirements for transportation projects. There are nine minimum requirements identified that address the stormwater impacts from quality, quantity and erosion control. This manual was written to be equivalent to the Washington State Department of Ecology's (WSDOE's) SWMMPSB (1992), and it is currently being revised to reflect updated technical guidance in the SWMMWW (2001).A revised version of the HRM is currently planned for August 2003. . Since drainage design and permitting would occur after the manual is revised, the Trans-Lake project would be subject to specific drainage criteria in the updated HRM. These requirements are expected to closely reflect new stormwater design guidance identified in the SMMWW. It is expected these requirements would be similar to or stricter than local (city) stormwater standards.

2.2.3 Stormwater IL (2002)

In response to new 4-D requirements for listed species under the ESA and the need to transition to new standards in the SWMMWW, WSDOT has issued several interim stormwater guidance documents, the latest being IL 4020.02 (February 2002). In summary, it specifies a treatment Level C for projects such as Trans-Lake that are scoped for construction after October 2005. This level directs designers to use the revised HRM yet to be developed and the following: for detention, use the flow duration standard in SMMWW; for treatment of roadways with average daily traffic (ADT) greater than 50,000, use infiltration (if possible) with "basic" treatment, or "enhanced" treatment in the SWMMWW. This guidance also specifies designers determine the practicability of such treatment levels and treatment of existing roadway surfaces.

2.2.4 SWMMWW (2001)

As part of the National Pollutant Discharge Elimination System (NPDES) Phase 2 permit process, the WSDOE has produced this manual as a basis for local jurisdictions and WSDOT to update their respective stormwater requirements. Since current WSDOT stormwater design guidance in IL 4020.02 indicates this manual should be used for detention and water quality standards (with some qualifications as described in Section 2.4, Water Quality), this manual is used as a primary reference for stormwater design standard assumptions for the project.

2.2.5 Stormwater, Grading, and Drainage Control

This is the current Seattle drainage development requirements, and it is outlined in four technical volumes. The water quality and detention requirements for the Seattle area basins in which the project is located (Lake Union, Portage Bay, and Lake Washington) are similar to those in the SWMMWW. The Seattle code also does not require detention for discharges to these waters and requires similar water quality treatment standards as the "basic" treatment level in the SWMMWW.

2.2.6 KCSWDM (1979)

This manual precedes other manuals described in this section and is considered less stringent for water quality and detention than current King County and State of Washington requirements. Use of this manual is not expected on this project.

2.2.7 KCSWDM (1998)

This manual is the current King County design reference and is also adopted by some cities in the region. Significant features are location-specific detention and water quality requirements. Continuous flow model detention standards (Levels 1, 2, and 3), and three treatment menus are used. King County is in the process of revising this manual to comply with the SWMMWW. Use of this manual is not expected to guide detailed design, but it is used as a reference to estimate stormwater detention volumes as further discussed in Section 2.3, Detention.

2.2.8 SWMMPSB (1992)

This reference contains current stormwater requirements for NPDES Phase 1 jurisdictions in the Puget Sound Basin. The manual includes ten minimum requirements for controlling stormwater impacts in the areas of erosion control, streambank erosion, and water quality. The SWMMWW (2001) was written to replace this manual as part of NPDES Phase 2. The SWMMPSB reflects current requirements for those jurisdictions that have adopted it until revised manuals are written and approved. Use of the manual is not expected on this project.

2.2.9 City of Bellevue Master Drainage Plan (1976)

This document describes the City's stormwater management program with an emphasis on stream protection and prevention of flooding, erosion, and sedimentation. The plan documents the City's selected strategy of providing in-stream storage ponds at strategic locations and requiring runoff control from developing properties.

2.2.10 Bear Creek Basin Plan (1990)

This plan contains basin-specific stormwater requirements for the eastern end of the project discharging to Bear Creek. The following basin-wide and subbasin recommendations in the plan apply to the lower reach of Bear Creek:

- Basin-Wide (BW-2) On-Site Detention Standards: Subcatchments B0a and B0b require 1990 King County Manual Standards for detention; this standard, however, is amended as the 1998 King County Level 1 Detention Standard.

- Lower Bear (LB-4) Infiltration: Infiltration of runoff in noncommercial and industrial areas with outwash soils to the maximum extent possible.

2.2.11 Redmond Stormwater Technical Notebook (1999)

This reference is the City's amendment to the SWMMPSB and contains a few modifications to it, including the following:

- Predeveloped landcover for detention sizing is forest (projects on hilltops) and meadow (projects lowlands).

- Infiltration is to be used as a last option for discharging surface water.

As mentioned, the SWMMPSB has been revised and is not expected to be a significant reference for this project. Similar to other City references, it is expected this manual will also be revised to reflect new stormwater guidelines in the SWMMWW.

2.3 DETENTION

Controlling stormwater runoff will be necessary to prevent potential erosion and possibly exceeding downstream conveyance capacities. The expected general detention standard for the project is described in the SWMMWW as the Western Washington Standard Requirement. This specifies controlling developed flow durations to predeveloped durations for flows between 50 percent of the 2-year flow to the 50-year flow. This is considered by WSDOE to be equivalent to King County's Level 2 flow control standard. Since volume estimate methods are available for Level 2 developed by King County, a Level 2 standard was assumed for estimating volumes in all basins tributary to streams subject to detention.

Detention of discharges to certain large water bodies are recognized as having negligible benefits due to their ability to absorb stormwater flows over their large volumes. The SMMWW specifies Lake Union, Lake Washington, and Lake Sammamish as exempt from detention (major receiving waters) and allows local agencies to petition WSDOE to include other water bodies not listed. Currently, Redmond and King County standards do not require detention for discharges to the Sammamish River. Discussions with the City of Redmond, King County, and WSDOT indicate that they intend to petition WSDOE to include the Sammamish River as exempt in revised stormwater requirements. It is therefore assumed detention of runoff to the Sammamish River will not be required on this project.

In addition, basins with discharges to City storm drains conveyed directly to major receiving waters (i.e., Lake Sammamish Basin) would need detention to revised City standards. These are locations where storm drain capacity is of concern rather than streambank erosion. A King County Level 1 detention standard using grass landcover is assumed here.

The detailed design of detention facilities on this project is expected to use software still being developed. Accompanying the SWMMWW, WSDOE has developed and released an initial version of the Hydrologic Simulation Program-Fortran (HSPF)-based hydrology model Western Washington Hydrology Model (WWHM). This model predicts predeveloped and developed flows and durations, but it currently does not size detention facilities directly. In addition, as part of its HRM revision process, WSDOT is developing another HSPF model for roadway detention design called MGSFLOOD; this model is expected to provide facility-sizing capability and other features relevant to roadway projects, but it is not yet available for use. In addition, future versions of BOSS StormShed™, a popular, detention-sizing software, may allow using HSPF-based pond sizing methods.

The amount of impervious roadway surface area proposed for flow control and treatment has a significant influence on the facilities' size. Detention volume estimates in this report assume that runoff from both existing and new pavement in the project corridor is to be detained. This assumption is consistent with WSDOT's HRM and criteria used on other WSDOT mobility projects. It should be recognized there are locations where stormwater cannot or would not be practical to detain or treat because of site constraints or other limitations. In addition, the HRM indicates the practicability of detaining runoff from existing pavement should be considered.

2.4 WATER QUALITY

The SWMMWW specifies water quality treatment levels based on the specific receiving water to which the project discharges. It identifies Lake Union, Lake Washington, and Lake Sammamish as "basic treatment receiving waters." This treatment level specifies a performance goal of 80 percent removal of total suspended solids (TSS). This is the assumed treatment level for discharges to these water bodies. However, since Lake Sammamish is identified locally as "phosphorus sensitive," it is assumed discharges to it will be treated for phosphorus removal. The SWMMWW indicates project discharges from highways to fish-bearing streams and their tributaries should provide "enhanced treatment", which has an additional goal of metal removal. This treatment level is assumed in the stream basins on the project's eastside.

The amount of impervious roadway surface area proposed for treatment has a significant influence on the facilities' size. Treatment volume estimates in this report assume that runoff from both existing and new pavement in the project corridor is to be treated. This assumption is consistent with WSDOT's HRM, the Puget Sound Highway Runoff Program, and criteria used on other WSDOT mobility projects. It is recognized there are locations where stormwater will be difficult to treat or cannot be treated because of site constraints or other limitations (such as the floating bridge or isolated portions of the roadway). In addition, the HRM indicates the practicability of treating runoff from existing pavement should be considered.

Detailed design of water quality facilities will involve calculating stormwater runoff volumes and flow rates using one or more methods, such as continuous flow methodology for flow rate-based best management practices (BMPs) and Santa Barbara Urban Hydrograph (SBUH) methodology for volume-based BMPs.

2.5 BEST MANAGEMENT PRACTICES

A variety of facility types are available when considering potential stormwater management facilities on the project. Since the various detention and water quality options require different space requirements, and available space along the corridor is highly developed, using space efficiently will be necessary. The size of the areas being treated, the extensive storm drains along the corridor, and limited right-of-way also limit the types of facilities considered. For example, filter strips are generally not practical in most project areas for these reasons. The remainder of this section discusses some of the BMPs considered for the project.

2.5.1 Wet Ponds and Detention Ponds

Wet ponds and detention ponds are constructed stormwater ponds designed to hold a permanent pool of water and remove pollutants primarily through settlement. Like most volume-based BMPs, their effectiveness is related to the stormwater stored. Wet ponds treat stormwater in the lower permanent pool, while detention in the upper portion of the pond control flow rate and flow durations. These ponds typically have a minimum of two cells, with the first cell designed for a majority of the sediment collection and where most maintenance is needed.

2.5.2 Wet Vaults and Detention Vaults

Wet vaults that contain a permanent pool of stormwater while detention vaults contain a fluctuating pool. These are underground structures that are proposed in areas with limited space such as adjacent to highly developed sites or topographical constraints. Although vaults are more space efficient than aboveground facilities, they are more expensive to construct and require different equipment (such as vactor trucks) to maintain. Since they store water underground, they lack the biological processes available in ponds. In appropriate areas, some vaults can be constructed with open tops (with no top slab) to improve their water quality performance.

2.5.3 Stormwater Treatment Wetlands

This BMP, introduced in the SWMMWW, is a modification of the traditional wet pond described above and is a form of “enhanced” treatment. Similar to wet ponds, this BMP also contain a minimum of two cells. The second cell, however, is shallower than a wet pond and contains emergent wetland plantings, the primary process for removing sediments, and metals that bind to organic material. This BMP is generally larger than wet ponds since they are shallower.

Stormwater treatment wetlands generally integrate better into a site’s surroundings. For example, they would be planted with vegetation complimenting existing vegetation, contain natural (instead of piped) outlets to the shore where possible, and potentially be incorporated into open space areas. These design features would be beneficial in certain areas of the project, such as the Portage Bay and Union Bay Basins where the stormwater facilities would be in or near public recreation areas. Using this BMP in these basins could technically exceed treatment level requirements indicated in the SWMMWW, since basic treatment is specified for them.

2.5.4 Media Filters

This BMP is added downstream of a traditional wet pond or bioswale to provide a form of enhanced treatment. Media filters are typically an enclosed unit, such as a vault or similar housing that contain cartridges or fixed beds of filter media. The media selected for the units are specific to targeted pollutants, such as metals and phosphorus. The units can be placed upstream or downstream of detention BMPs, but they would require larger units if placed upstream. These BMPs would be a new form of treatment of WSDOT runoff and would require additional maintenance to monitor and replace media as needed or specified.

2.5.5 Biofiltration Swales

Biofiltration swales are vegetated channels designed to remove pollutants at a specified flow rate through filtration and plant uptake. These BMPs have been installed on many WSDOT projects; however, the SWMMWW has increased residence time requirements resulting in significantly longer swale lengths or wider cross-sections. These revisions will limit use to areas with suitable room, such as spacious roadsides.

2.5.6 Emerging Technologies

This class of stormwater treatment includes new technologies that currently have not been evaluated sufficiently but may be found to provide acceptable treatment levels after further data collection. These "Ultra-urban" stormwater treatment technologies can be used to remove stormwater pollutants in areas with limited available space. These largely commercial devices can be grouped into the following categories: media filters, amended sand filters, catch basin inserts, manufactured storm drain structures (including vortex-enhanced sedimentation, media filtration, screening systems, and engineered cylindrical sedimentation), and high efficiency street sweepers.

APWA protocol has been developed to evaluate these new technologies, and as a basis to review data and equivalent protocol submitted by local governments. WSDOT is currently working on testing a variety of emerging technologies using highway runoff.

2.5.7 Oil Control

Additional oil control treatment of "high-use " sites is included in the SWMMWW. These are areas that have a traffic turnover rate high enough to generate larger oil concentrations. On roadway projects, these sites are intersections with an ADT of at least 25,000 on the main roadway and 15,000 on the intersecting roadway. 2001 traffic counts indicate the following intersections in the project area meet (or are close to meeting) this criteria and may require oil control treatment if roadway improvements at the intersections are proposed:

Montlake Blvd/Lake Washington Blvd (close to ADT criteria)
Montlake Blvd/Pacific Street (close to ADT criteria)
Bellevue Way NE/Northup Way; (close to ADT criteria)
148th Avenue NE/NE 24th Street;
148th Avenue NE/NE 20th Street

Traffic data should be reviewed later during design to confirm these levels of traffic.

BMP options for high-use intersections currently include an American Petroleum Institute (API) oil/water separator, a coalescing plate oil /water separator, and catch basin inserts. The selected option for these locations should be chosen based on WSDOT (or City) preferences, depending on the jurisdiction responsible for their maintenance.

2.6 PRELIMINARY FACILITY SIZING METHODS AND ASSUMPTIONS

Since the size of detention and water quality facilities are directly related to the quantity of roadway surface they are treating, a unit volume approach was used to estimate the impervious surface areas within each basin (or smaller subbasin with it). These areas were determined from preliminary roadway highway profiles and pavement areas on computer-aided drafting and design (CADD) drawings. Roadside areas and pedestrian trails were not assumed to significantly contribute to detention and treatment facilities since these areas should not be considered pollution-generating and may not need to be directly connected to storm drains/facilities (see Low Impact Development Practices.). Information in the original hydraulic reports and contract plans were checked regarding basin boundaries, impervious area, and other drainage details.

As mentioned, detailed design of stormwater facilities are expected to use methods described under Sections 2.3, Detention, and 2.4, Water Quality. Volumes for proposed stormwater detention facilities were calculated using King County Runoff Time Series (KCRTS)-based estimate methods, and should be reasonable estimates of WWHM requirements. For areas of the project discharging directly to streams, unit volumes of 17,690 cubic feet per acre (cf/ac) of impervious surface area (Level 2) were developed using the spreadsheet estimate methodology prepared by King County Department of Natural Resources and Parks (Reference 6). These unit volumes assume the developed conditions to be paved and predeveloped conditions to be forestland, in till soils. For the basins discharging to City of Redmond stormdrains (i.e. Lake Sammamish basin), unit volumes of 10,200 cf/ac were assumed. This reflects detention for added pavement using pasture cover as predeveloped conditions in till soils. In addition, a precipitation factor of 1.0 is assumed based on its proximity to the Seattle-Tacoma International Airport precipitation gage.

Required water quality treatment volumes were estimated at 4,640 cf/ac of impervious surface area, which is approximately 72 percent of the total runoff volume in a typical SBUH 2-year, 24-hour design storm in the Seattle-Bellevue area. This is the specified water quality design storm for volume-based BMPs in the SWMMWW.

The estimated volumes for detention and treatment and assumed available depths at the identified locations (or existing pond depths for enlarged facilities) were then used to estimate area required. For ponds, an additional allowance of 50 percent beyond the surface area for areas such as berms and maintenance access was initially calculated. Since space is typically limited in the corridor, opportunities for reduced total area (such as using walls) was considered. Proposed facility locations were selected by considering the modification of existing facilities, and new facilities at discharge locations with larger tributary areas that lack them.

Tables A1 and A2 in Appendix A identify drainage basins, impervious surface estimates, and calculated storage volumes for the 8-, 6-, and 4-lane alternatives. In basins with multiple discharge locations, smaller subbasins were identified to calculate separate contributing areas (“Lake Union South” for example).

3. EXISTING CONDITIONS

3.1 GENERAL DRAINAGE CONDITIONS

I-5 generally consists of four general purpose lanes in each direction with four reversible lanes; SR 520 consists of two general purpose lanes in each direction between I-5 and 108th Avenue NE and an additional HOV lane in each direction east of 108th Avenue NE. Conveyance facilities consist of storm drains, bridge drains, ditches, and culverts, which were installed between the late 1950s and the present. There are no existing stormwater management facilities in the project area between I-5 and approximately 108th Avenue NE in Bellevue. Recent SR 520 capacity improvements constructed bioswales, ponds, and vaults between 108th Avenue NE and Union Hill Road in Redmond. **Table 3.1** provides general descriptions and anticipated impacts of these.

Depending on the alternative, the project area crosses up to 14 drainage basins between Seattle and Redmond. **Figure 1.1** identifies drainage basins and their roadway stationing boundaries. See **Chapter 4** for descriptions of general drainage conditions within each basin.

3.2 SOILS

This section describes the soils in the project corridor. In Seattle, published U. S. Soil Conservation Service (SCS) maps are not available. Earlier guidance from Department of Construction and Land Use (DCLU) staff indicate Alderwood (type C) soils should be assumed for pervious areas; this corresponds to a till soil.

On the Eastside, Soil Conservation Service maps indicate a majority of the soils along the corridor are characterized as the following type C/D (till): Alderwood (AgB, AgC, AgD); Bellingham (Bh); Kitsap (KpB, KpC, KpD); Norma (No); Shalcar (Sm) and Urban (Ur). These soils generally have medium to high runoff rates. In addition, there are locations in the basins with the following type A/B (outwash) soils: Everett (EvC) and Indianola (InA). These areas are in portions of the Yarrow Creek, West Kelsey Creek, Valley Creek, and Bear Creek basins. These are soils with generally medium to high infiltration rates.

It should also be noted there are areas of the project that have been previously identified as having unstable soils. These include areas near Sites LU-1 and YC-1 which may affect design of these facilities (see Section 4).

Table 3.1 Summary of Existing Stormwater Facilities

Description	Location	Tributary To	Size	General Impacts		
				4-Lane	6-Lane	8-Lane
Pump station	I-5 2340 + 00 Rt	Lake Union	10 horsepower duplex	None	Additional flow	Additional flow
Biofiltration swale	SR 520 354+00 Rt	Yarrow Creek	200 feet	Don't know	Conflicts with roadway	Conflicts with roadway
Biofiltration swale	364+00 Lt	Yarrow Creek	200 feet	None	Conflicts with new pond	Conflicts with pond
Detention and water quality pond	376+50 Lt	Yarrow Creek	Don't know	None	Conflicts with roadway	Conflicts with roadway
Biofiltration swale	384+50 Lt	Yarrow Creek	200 feet	None	Conflicts with roadway	Conflicts with roadway
Water quality and detention vault	425+00 Rt	West Kelsey Creek	300 feet X 20 feet X 6 feet (36,000 cubic feet)	None	Under offramp lane	Under offramp lane
Water quality and detention vault	511+00 Lt	Valley Creek	230 feet X 40 feet X 5 feet (46,000 cubic feet)	None	Conflicts with roadway	Additional flow
Biofiltration swale	529+00 Lt	Valley Creek	200 feet	None	Conflicts with roadway	Conflicts with roadway
Biofiltration swale	546+00 Lt	Sears Creek	200 feet	None	Conflicts with roadway	Conflicts with roadway
Biofiltration swale	551+00 Lt	Sears Creek	200 feet	None	Conflicts with roadway	Conflicts with roadway
Water quality and detention vault	573+00 Rt	Lake Sammamish	240 feet X 50 feet X 5.5 feet (54,000 cubic feet)	None	Additional flow	Additional flow
Biofiltration swale	600+00 Rt	Sammamish River	200 feet	None	None	Conflicts with roadway
Biofiltration swale	611+00 Rt	Sammamish River	200 feet	None	None	Conflicts with roadway
Biofiltration swale	628+50 Rt	Sammamish River	200 feet	None	None	Conflicts with roadway
Biofiltration swale	636+50 Rt	Sammamish River	200 feet	None	None	Conflicts with roadway
Biofiltration swale	649+00 Rt	Sammamish River	200 feet	None	None	Conflicts with roadway
Water quality pond	663+00 Lt	Sammamish River	400 feet X 100 feet X 703,000 cubic feet	None	None	Additional flow
Biofiltration swale	670+00 Rt	Sammamish River	300 feet	None	Additional flow	Additional flow
Water quality pond	712+00 Lt	Bear Creek	21,000 cubic feet	None	Overhead structure	Overhead structure
Water quality pond	715+00 Lt	Bear Creek	44,120 cubic feet	None	Overhead structure	Overhead structure
Infiltration pond	715+00 Rt	Bear Creek	42,000 cubic feet	None	None	None

4. DESCRIPTIONS OF SUBBASIN STORMWATER

This chapter describes existing and proposed drainage conditions in each project basin. Drainage basins are identified by the name of the receiving water that the roadway is tributary to. Since alignments and stationing vary between alternatives, the basin limits and drainage features refer to right-of-way centerline. The roadway drawings in Appendix B illustrate the estimated pond and vault footprint areas**.** Table 4.1 at the end of this chapter tabulates proposed stormwater management facilities, estimated sizes, and some expected features.

4.1 LAKE UNION BASIN (I5 STA 2260+00 TO 2360+00)

(City of Seattle)

Existing Drainage: The drainage system consists primarily of storm drains and bridge drains on the elevated structures. Runoff from I-5 between approximately Olive Way and East Lynn Street is conveyed in storm drains to East Garfield Street, where it flows west in a WSDOT storm drain to an outfall in Lake Union. The area beneath the Lakeview-Galer structure is currently experiencing extensive erosion due to deteriorating and leaking bridge drains and steep terrain. WSDOT is planning a project to repair a portion of these bridge drains and storm drains. Runoff from I-5 between East Lynn Street and the Ship Canal Bridge (including the SR 520 interchange) is conveyed north in storm drains to East Allison Street, where it flows west to an outfall in Lake Union. An existing stormwater pump station (approximately 30 feet deep) is located between the southbound and express lanes just south of the Roanoke Undercrossing, which pumps runoff from the depressed tunnel into the storm drain system conveyed to East Allison Street.

Proposed Drainage: Water quality wet vaults are proposed beneath the I-5 structures at East Garfield Street and East Allison Street (6- and 8-lane alternatives only). No detention is proposed since runoff is tributary to Lake Union. Existing WSDOT storm drains should be analyzed for impacts from additional flow and available capacity. Since additional flows are expected to be small compared to existing flows, no major capacity problems are expected. To accommodate possible seismic retrofit of bridge columns in the area, adequate clearance to vaults should be provided. As discussed earlier, only water quality treatment is proposed in this basin, and no detention is proposed.

Site LU-1: At Garfield Street, the wet vault would be located in existing right-of-way between the bridge columns in two or three spans north of the existing secured parking lot. Since they are located beneath the structure, no additional right-of-way is needed. The vault could be an open-top vault (no top slab) to facilitate water quality and maintenance. Since terrain under the structure slopes down to the west with possible soil instability, a vault located under the west edge of the structure appears most practical. A vault located here could treat the portion of northbound, southbound, and express lanes located between East Garfield and East Lynn Street. This would far exceed the total additional pavement in the basin and allow future vault expansion to the south. The area beneath I-5 in this area is being examined by Seattle Parks and Recreation Department for potential park improvements. Proposed drainage near any open space improvements should be designed to be compatible, considering elements of safety, visibility, and maintenance.

Site LU-2: This is an area located under the south approach to the I-5 Ship Canal Bridge, which was recently improved by WSDOT contractors, and experiences more space constraints than **Site LU-1**. A wet vault (water quality only) would be located beneath an existing paved area directly north of East Allison Street, between Fairview and Harvard Avenues East. Located beneath the structure, no additional right-of-way is needed. This vault would be below grade with a top slab due to surrounding improvements. Space constraints, such as providing clearance to existing bridge footings and utilities, make using an "emerging technology" (e.g., a vortex-type unit) an attractive option here. Since the proposed area to be treated (between the SR 520 interchange and the Ship Canal Bridge) far exceeds the additional roadway surface in this basin, a pollutant load reduction can be expected and may justify small performance differences with traditional BMPs.

4.2 PORTAGE BAY BASIN (SR 520 STA 5+00 TO 45+00)

(City of Seattle)

Existing Drainage: Runoff from this section of SR 520 between approximately East 10th Street and Montlake Boulevard is conveyed in storm drains and discharges to outfalls in Portage Bay under the SR 520 structure at Boyer Avenue East and under the Montlake Boulevard eastbound off-ramp. The portion of the roadway on viaduct discharges into bridge drains directly into Portage Bay.

Proposed Drainage: Since most of the roadway in this basin is constructed on an elevated structure, new bridge drains and storm drains would convey runoff east to two sites. The shoreline in this basin is regulated by the City of Seattle. A riparian setback of 50 feet from the shoreline has been assumed in siting stormwater facilities. As discussed earlier, only water quality treatment is proposed in this basin, and no detention is proposed.

Site PB-1: A wet vault located under the SR 520 viaduct between East Boyer and the shoreline is proposed. This vault could be an open-top structure located in existing right-of-way and would discharge to an outfall under the viaduct. Since significant additional flows to the existing outfall and storm drain are expected, a larger conveyance system into Portage Bay is likely needed at this location. The vault would be accessed for maintenance directly from Boyer Avenue East.

Site PB-2: A stormwater treatment wetland is proposed at the Montlake Boulevard interchange adjacent to the eastbound off-ramp. A sediment cell and planted cell would be located between the mainline, off-ramp, and shoreline. This area is constrained by topography and the shoreline.

4.3 UNION BAY BASIN (STA 45+00 TO 121+00)

(City of Seattle)

Existing Drainage: Runoff from this section of SR 520 between Montlake Boulevard and Union Bay is conveyed in storm drains that flow to the east and discharge to an outfall in Union Bay near the abandoned ramps to Lake Washington Boulevard. Runoff on the west bridge approach discharges from numerous bridge drains directly into Union Bay. SR 520 crosses Foster Island; however, no extensive drainage systems are located here except for roadside ditches. In this basin, SR 520 crosses the Washington Park Arboretum with a high degree of visibility and environmental sensitivity. Since it is anticipated that drainage facilities would be expected to integrate into existing environment to the greatest degree possible, stormwater treatment wetlands are proposed. The shoreline in this basin is regulated by the City. A riparian setback of 50 feet from the shoreline has been assumed in siting stormwater facilities in this area.

Proposed Drainage: The proposed drainage system would consist of storm drains conveying runoff to three stormwater facilities in or near the Washington Park Arboretum. As mentioned, these could be designed to integrate with surrounding environmental features.

Site UB-1a: For the 8 lane alternative, runoff from SR 520 and ramps between Montlake Boulevard and a crest in the alignment over Union Bay would be conveyed in new storm drains to a stormwater wetland located in the area currently occupied by the lower parking lot of the Museum of History and Industry. This facility would treat a relatively large portion of the corridor in this basin. The sediment cell may fit under the elevated structure. Treated discharges from the wetland cell would be conveyed east in a pipe under the tunnel road to Union Bay. Maintenance access could be from the tunnel road. On the south side of SR 520, ramp grades prevent using areas large enough for such a facility.

Site UB1b: For the 6 lane alternative, an area located between Lake Washington Blvd, SR 520 and the shore is available for a stormwater treatment wetland. A portion of it would be located under the east bound onramp. A sediment cell under the ramp would receive flows and discharge to the wetland cell. Treated flows would be conveyed east in an upgraded outfall to existing wetlands and Union Bay. Maintenance access would be from Lake Washington Blvd.

Site UB-2: Foster Island provides the last land-based stormwater facility location for the mainline on the west side of Lake Washington. The roadway profile could facilitate the conveyance of runoff west of the high-rise in storm drains to Foster Island. A stormwater treatment wetland is proposed that would include a sediment vault and a planted cell adjacent to the roadway on its south side. The alternatives are slightly different due to roadway variations; the 8-lane alternative can accommodate a sediment vault under the roadway in the median, while the vault is located adjacent to the eastbound shoulder for the 4 and 6 lane alternatives. The facility would discharge treated flows overland and higher flows in a new outfall to Union Bay on the west side of Foster Island.

Site UB-3: This stormwater treatment wetland is proposed in existing right-of-way located east of East Roanoke Street. It would treat flows from the elevated ramps to Lake Washington Boulevard (for the 4- and 6-lane alternatives) and a portion of reconstructed Lake Washington Boulevard (for the 8-lane alternative). Runoff from a storm drain on the elevated ramps (or Lake Washington Boulevard) would convey flows to the treatment facility and discharge flows overland to Union Bay. Access would be from Lake Washington Boulevard. This pond is located near an existing abandoned ramp to Lake Washington Boulevard, and would occupy a restored area once the structure is removed.

4.4 EVERGREEN POINT FLOATING BRIDGE (STA 121+00 TO 242+84)

Existing Drainage: Runoff from the floating bridge deck is conveyed into bridge drains that discharge directly into Lake Washington.

Proposed Drainage: The portion of the proposed floating bridge between the high-rises is currently proposed to be on elevated pontoons. Since traditional water quality strategies here are initially recognized as difficult and/or structurally infeasible, a more detailed analysis of potential treatment options and water quality impacts is requested by WSDOE to justify the selected option(s) for treating bridge deck pollutants. These reports, known as All Known, Available, and Reasonable Methods of Prevention, Control, and Treatment (AKART), and a water quality analysis will be prepared separately for review and concurrence by WSDOE and other agencies.

4.5 FAIRWEATHER BAY BASIN (STA 242+84 TO 281+00)

(City of Medina)

Existing Drainage: Runoff in this area discharges in storm drains and curb openings in multiple locations, eventually flowing to Fairweather Bay. In this basin, there are two small streams crossing under the roadway in culverts. Just upstream of Fairweather Park, a culvert beneath SR 520 conveys flows to a diversion structure constructed by City of Medina. Low flows are conveyed through Fairweather Park, while high flows are conveyed around the park and down a storm drain in 80th Avenue NE to Fairweather Bay. The second crossing is Fairweather Creek beneath the eastbound off-ramp, which conveys flows in a relatively steep, short reach to Fairweather Bay.

Proposed Drainage: Conveyance systems would consist primarily of storm drains flowing east to 84th Avenue NE. A wet pond is proposed inside the loop ramp at the westbound on-ramp at 84th Avenue NE **(Site FB-1)**. Perimeter walls would be needed for the 6- and 8-lane alternatives. Treated flows would discharge in a new pipeline to the west beneath the proposed bicycle and pedestrian path and then to a new outfall in Fairweather Bay. This outfall would be located adjacent to a residential property that would be displaced by the 8-lane alternative; it would require an easement for the other alternatives. Maintenance access would be from the ramp.

4.6 COZY COVE BASIN (STA 281+00 TO 309+77)

(City of Hunts Point)

Existing Drainage: Runoff from SR 520 between the 84th Avenue NE interchange and the 92nd Avenue NE interchange is conveyed west along SR 520 in curb and ditches discharging in several locations but primarily to an unnamed creek crossing under the highway just east of 84th Avenue NE. Scuppers along the centerline barrier are necessary since there are no storm drains here. In this basin, the roadway is bordered by wetlands and Hunts Point to the north.

Proposed Drainage: Limited right-of-way and sensitive areas would require storm drains to convey flows to a wet vault **(Site CC1)** for treatment before discharging to the unnamed stream. The vault would be located under the proposed bicycle and pedestrian path and westbound shoulder just east of the 84th Avenue NE interchange. A media filter providing enhanced treatment to a fish-bearing stream is assumed. Similar to other streams on the project, fish presence studies will be conducted later to confirm this assumption. Low flows could be directed to the vault and higher flows to the outfall downstream of **Site FB1**.

4.7 YARROW CREEK BASIN (STA 309+77 TO 403+45)

(Cities of Kirkland and Bellevue)

Existing Drainage: Between 92nd Avenue NE and 116th Avenue NE, the SR 520 drainage system consists of ditches, extensive storm drains, several bioswales, and a detention pond discharging to Yarrow Creek and its tributaries. Two primary points of discharge to Yarrow Creek in this basin are at the 108th Avenue NE and Bellevue Way interchanges. SR 520 crosses Yarrow Creek in two locations (Bellevue Way interchange and 108th Avenue NE) and also crosses two tributaries (just west of Bellevue Way and just east of the 108th Avenue NE interchange.)

Proposed Drainage: New and existing storm drains would convey runoff to a vault and several stormwater treatment wetlands along the corridor.

Site YC-1: A detention and wet vault between the mainline and eastbound ramp to Bellevue Way would detain and treat mainline runoff west of this location and discharge to a Yarrow Creek tributary crossing the roadway. A media filter downstream of the vault is also proposed for enhanced treatment. Due to the profile grade of SR 520 and length, the vault could have a multiple bottom elevations to minimize excavation and its depth. The vault could have an open top and would be maintained from the right eastbound shoulder. Since this area of the project was subject to a landslide during original highway construction, geotechnical considerations should be part of the vault design.

Site YC-2: At the Bellevue Way interchange, a detention and stormwater wetland is proposed between SR 520, Lake Washington Boulevard, and Hunts Point Drive. The pond would discharge to Yarrow Creek, which crosses under the Lake Washington Boulevard and Hunts Point Drive intersection into existing wetlands. A portion of the facility for the 6- and 8-lane alternatives would be under the eastbound off-ramp structure. Limited space would require retaining walls along Lake Washington Boulevard. Maintenance access would be from Hunts Point Drive.

Site YC-3: Runoff from the SR 520 and I-405 interchange and SR 520 to just east of the 108th Avenue NE ramps would be conveyed in existing and new storm drains to areas north of SR 520. Current roadway plans indicate these properties between SR 520, Northup Way, I-405, and the WSDOT maintenance facility would be displaced due to ramp construction. This area is currently occupied by several office buildings. A series of large stormwater wetlands with detention are proposed along Northup Way that would discharge treated flows to a new conveyance system on the north side of SR 520. This would be conveyed to the Yarrow Creek tributary just east of NE 108th Avenue. Maintenance access would be from Northup Way.

Site YC-4: A combination detention and water quality treatment is proposed at the base of the existing westbound ramp to 108th Avenue NE (to be removed). This location is in the vicinity of the confluence of Yarrow Creek and a tributary. Removing and restoring two culverts due to ramp removal would further facilitate construction of this facility. Maintenance access would be from 108th Avenue NE.

4.8 WEST KELSEY CREEK BASIN (STA 403+45 TO 450+16)

(City of Bellevue)

Existing Drainage: Storm drains are used primarily in this basin, which convey SR 520 runoff to a single discharge location at 120th Avenue NE where it flows south in City storm drains to Kelsey Creek. There is an existing large water quality and detention vault under the eastbound 124th Avenue NE off-ramp shoulder and roadside.

Proposed Drainage: This is an area with space constraints due to limited roadside areas and developed properties. Expanding the existing vault does not appear practical due to its location under the proposed roadway.

Site KC-1: A wet pond with media filter is proposed under an elevated structure between the 120th Avenue NE and NE 24th Street connector road and realigned Northup Way. The pond would treat and detain a majority of the flows east of this location and require new storm drains to convey flows to it. The pond would discharge to existing storm drain in 120th Avenue NE and would be maintained from the connector road under the structure. Due to revised roadway grades on Northup Way, a retaining wall along this road would be necessary to contain the volume in the pond here.

Site KC-2: At this site, a stormwater treatment wetland with is located between SR 520 and realigned. NE 24th Street. The pond would also treat and detain a smaller quantity of flow east of this location and also require new storm drains for conveyance to it. Due to space constraints, walls would also be necessary to provide the required volumes. A two-celled, stepped configuration may also reduce excavation.

4.9 GOFF CREEK BASIN (STA 450+16 TO 461+50)

(City of Bellevue)

Existing Drainage: Runoff is conveyed in short segments of storm drain from the roadway to the toe of the roadway slope, where it flows in ditches to Goff Creek. This urban creek crosses SR 520 through twin culverts approximately 200 feet east of 130th Avenue NE, then south beneath an office complex parking lot.

Proposed Drainage: At **Site GC-1**, a vault on the south side of SR 520 east of the creek is proposed. A media filter providing enhanced treatment is also assumed. The vault could be benched into the fill slope and incorporated into a retaining wall for the roadway fill in this area. The vault could be entirely or partially covered, would abut existing commercial parking and discharge to the creek. Maintenance access would be from 130th Avenue NE.

4.10 VALLEY CREEK BASIN (STA 461+50 TO 527+00)

(City of Bellevue)

Existing Drainage: Valley Creek crosses SR 520 just east of 140th Avenue NE. Runoff from the roadway in this basin is conveyed in storm drains, slope drains, and ditches, and then discharges to the creek in two locations. These two locations where it crosses at 140th Avenue NE and at NE 24th Street are where flows are conveyed west to the City's Valley Creek stormwater facility/wetland. There is a large water quality/detention vault under the westbound shoulder, pedestrian trail and roadside between NE 29th Place and SR 520.

Proposed Drainage: Since the roadway is constructed on relatively high fills and cuts in this basin, storm drains would be used as conveyance. A combination of open ponds and vaults are proposed.

Site VC1: A stormwater wetland with detention is proposed on the north side of SR 520 between a wooded hillside and a strip mall. The property is currently developed with a commercial business and associated parking and would need to be acquired. The facility would be accessed for maintenance from 136th Place NE and discharge flows to the ditch and culvert beneath SR 520. This pond would be similar in size for the 6- and 8-lane alternatives because **Site VC2** is not proposed for the 6-lane alternative.

Site VC-2: Adjacent to and upstream of **Site VC-1**, a closed detention vault under the westbound shoulder and pedestrian trail would detain additional stormwater conveyed from the west. This facility supplements **Site VC-1** and reduces total drainage right-of-way impacts in the area. It would discharge into pond at **Site VC-1** and be accessed from the westbound shoulder or pedestrian trail on SR 520.

Site VC-3: On the north side of SR 520 between NE 24th Street and an area adjacent to Valley Creek and a tributary would serve as a location for a combined detention and stormwater treatment wetland. The side of the roadway has recently been graded to accommodate widening and a bioswale. The facility would be relatively long and narrow due to proximity to the streams. Maintenance access would be from 140th Avenue NE where earlier construction access has been used.

Site VC-4: To provide for enhanced treatment of runoff, a media filter could be added to the existing detention /wetvault between NE 29th Place and SR 520 . The modified vault would be accessed from the pedestrian trail on the SR 520 roadside, as it is today. The roadway surface tributary to this vault requires a small amount of widening, and would not likely warrant a larger disturbance of the vault.

4.11 SEARS CREEK BASIN (STA 527+00 TO 564+67)

(City of Bellevue)

Existing Drainage: The drainage system in this basin consists of storm sewers and several bioswales. Just east of 148th Avenue NE, the storm sewer conveying flows west along the median contains a manhole that splits flows between Sears Creek to the south and Valley Creek to the west. Stormwater exits the right-of-way flowing east in a storm drain across a parking lot to 152nd Avenue NE. The storm drain downstream of SR 520 is relatively shallow and limits detention depths.

Proposed Drainage: Storm drains would convey runoff westerly in existing and new storm drains. Two detention and stormwater wetlands (**Sites SC-1 and SC-2**) are proposed inside the loop ramps at 148th Avenue NE. These areas are currently covered with significant amounts of stockpiled soil material and landscaping from recent roadway construction and, hence, would require large excavations to construct the ponds. Maintenance access would be provided from the ramps.

4.12 LAKE SAMMAMISH BASIN (STA 564+67 TO 589+25)

(City of Redmond)

Existing Drainage: The storm drains in this basin convey runoff from the sag in the roadway profile and discharges flows to an existing water quality and detention vault. Located in the Sound Transit facility at NE 40th Street and 156th Street, the vault discharges to a City of Redmond storm drain flowing east on NE 40th Street to Lake Sammamish.

Proposed Drainage: Since most of the roadway widening is currently in place, drainage modifications would consist of developing connections to existing storm drains and using the existing detention and water quality vault for the 8-lane alternative only.

Site LS-1: Due to built-out conditions and discharge to City storm drains, a modification to the existing water quality and detention vault to detain (and treat) the added impervious to a conveyance protection standard is assumed. Since additional water quality treatment of phosphorus in this basin is needed, a media filter targeting this pollutant is proposed down stream of the vault. Tailwater conditions in the City storm drain may restrict the location of a media filter.

4.13 SAMMAMISH RIVER BASIN (STA 589+25 TO 700+00)

(City of Redmond)

Existing Drainage: Runoff between approximately NE 40th Street vicinity and SR 202 interchange ramps is conveyed to the Sammamish River in storm drains, ditches, and several bioswales. West of the river a trunkline under the median barrier conveys on-site and off-site flows to a large water quality pond in the westbound loop ramp to West Lake Sammamish Parkway. East of the river, runoff on the south side of SR 520 flows west in a ditch and bioswale to the river. Outfalls to the river are located on each side of the SR 520 overcrossing. East of the river, road profile is very flat. Additional Bear Creek channel improvements north of the roadway are planned by the City of Redmond that would alter current floodplain and buffer locations adjacent to SR 520.

Proposed Drainage: West of the river the existing storm drains would continue to convey the drainage. East of the river, a combination of storm drains and bioswales could provide conveyance and treatment. As discussed earlier, only water quality treatment is proposed in this basin, and no detention is proposed.

Site SR-1: West of the river, using the existing water quality pond for treatment appears feasible since there is adequate volume for the calculated SR 520 runoff. The existing pond needs to be modified to provide stormwater wetland features such as a deeper sediment pool depth and a reduced planted cell depth. Since off-site stormwater is also tributary to this pond, an upstream flow splitter is an option to improve hydraulics. No detention is proposed as discussed earlier.

Site SR-2: East of the river, a bioswale and media filter is proposed on each side of SR 520. Significantly higher residence time requirements results in longer swales in this location. In addition, a media filter downstream of the swales is proposed to satisfy enhanced treatment requirements. On the north side of SR 520, locating the swale in the Bear Creek buffer appears necessary, but should be confirmed when a final stream alignment is available. The swale on the south side requires a short narrow barrier such as a block wall to avoid impacts to Marymoor Park and potential wetlands.

4.14 BEAR CREEK BASIN (STA 700+00 TO 736+00)

(City of Redmond)

Existing Drainage: Runoff between the SR 520 and Redmond Way (SR 202) interchange and Union Hill Road is conveyed to Bear Creek. Also, on the north side of SR 520 between the Sammamish River and Redmond Way (SR 202), runoff sheet flows into Bear Creek. In the lower reaches of Bear Creek near the Sammamish River, the City of Redmond is planning realignment and habitat improvements to Bear Creek. South of Redmond Way, runoff in the interchange area flows in storm drains and ditches to two wet ponds (water quality only) adjacent to the westbound on ramp and to an infiltration pond near the eastbound off-ramp terminal. These ponds discharge to Bear Creek near the westbound on-ramp. Upcoming improvements to SR 202 include using the existing infiltration pond. North of the interchange, SR 520 and the local connector roads discharge under SR 202 in a storm drain to a wet pond described above.

Proposed Drainage: Conveyance improvements would consist of connecting into recently constructed storm drains. Two stormwater wetlands with detention are proposed in this basin.

Site BC-1: Expanding the existing water quality pond adjacent to SR 202 to the south (under the existing SR 202 Bridge) would use this available area and not require additional right-of-way. Future East Lake Sammamish Trail construction does not conflict with the facility but would need to be considered later in design.

Site BC-2: In the southeast quadrant of the interchange, a new stormwater wetland with detention is proposed inside existing right-of-way. This would treat the portion of the project north of SR 202 and the eastbound off-ramp. Flows from the facility would discharge across SR 202 and in new storm drains around Site BC1.

Table 4.1 Summary of Proposed Stormwater Facilities

Site ID	Description	Location	Tributary To	Estimated Size By Alternative (square feet) 4-Lane	6-Lane	8-Lane	Right-of-Way Needed?	Notes
LU-1	Wet vault	I-5 2305+00 Lt	Lake Union	N/A	80 X 50 X 5 (2)	80 X 50 X 5 (2)	No	1,3,6
LU-2	Emerging technology best management practice	2362+ 00	Lake Union	N/A			No	2,6
LU-3	Pump station	2340 + 00 Rt	Lake Union	N/A			No	2
PB-1	Wet vault	SR 520 20+00	Portage Bay	130X40X6	165 X 40 X 6	165 X 40 X 6	No	4,6
PB-2	Stormwater wetland	44+00 Rt	Portage Bay	13674	17,000	17,000	No	4
UB-1	Stormwater wetland	58+00 Lt	Union Bay			24,592	Yes	4,6
UB-1b	Stormwater wetland	61+00 Rt	Union Bay	29600	34000	--	No	4,6
UB-2	Stormwater wetland	84+00 Rt	Union Bay	20017	26,139	33,717	Yes	4
UB-3	Stormwater wetland	LWB 62+00 Lt	Union Bay	N/A	3,093	N/A	No	4
FB-1	Wet pond	SR 520 274+00 Lt	Fairweather Bay	13493	17,462	19,722	No	1
CC-1	Wet vault with media filter	280+00 Lt	Union Stream/Cozy Cove	185X30X6	275 X 30 X 6	315 X 30 X 6	No	2,4
YC-1	Wet vault with media filter	339 + 00 Rt	Yarrow Creek	335X45X7	495 X 45 X 7	545 X 45 X 7	No	2,3
YC-2	Stormwater wetland with detention	348 + 00 Lt	Yarrow Creek	57487	84,919	93,850	Yes	1,6
YC-3	Stormwater wetland with detention	380+00 Lt	Yarrow Creek	N/A	336,009	350,939	Yes	4,6
YC-4	Stormwater wetland with detention	367+00 Lt	Yarrow Creek	N/A	184,00	19,200	No	4
KC-1	Wet pond with media filter	415+00	West Kelsey Creek	N/A	74,400	82,000	No	1,6
KC-2	Stormwater wetland with detention	418+00 Lt	West Kelsey Creek	N/A	35,100	39,000	No	1
GC-1	Wet vault with media filter	457+00 Rt	Goff Creek	N/A	305 X 40 X 6	370 X 40 X 6	No	1,4
VC-1	Stormwater wetland with detention	485+00 Lt	Valley Creek	N/A	52,000	52,000	Yes	
VC-2	Detention vault	481+00 Lt	Valley Creek	N/A	NFP	340 X 20 X 7	No	
VC-3	Stormwater wetland with detention	502+00 Lt	Valley Creek	N/A	30000	41600	No	4
VC-4	Media filter on existing vault	511+00 Lt	Valley Creek	N/A			No	2
SC-1	Stormwater wetland with detention	527+00 Rt	Sears Creek	N/A	93,000	107,000	No	
SC-2	Stormwater wetland with detention	530+00 Lt	Sears Creek	N/A	60,000	69,000	No	
LS-1	Expand existing wet vault and media filter	573 + 00 Rt	Lake Sammamish	N/A	NFP	90 X 50 X 5.5	Yes	2, 5
SR-1	Modify existing wet pond	663 + 00 Lt	Sammamish River	N/A	NFP	56,977	No	
SR-2	Biofiltration swale with media filter	675 + 00 Lt	Sammamish River	N/A	1,070 X 30	1,070 X 30	No	4
SR-3	Biofiltration swale with media filter	681 + 00	Sammamish River	N/A	1,000 X 20	1,000 X 20	No	4
BC-1	Stormwater wetland with detention	715+00 Lt	Bear Creek	N/A	67,200	74,800	No	
BC-2	Stormwater wetland with detention	718+00 Rt	Bear Creek	N/A	103,800	105,000	No	

Notes:
Stationing as shown on 8-lane roadway drawings.
N/A Not applicable (outside this alternative's project limits)
NFP No facility proposed (no added impervious or widening in this subbasin proposed).

1. Retaining wall(s) needed.
2. Size dependent on manufacturer selected.
3. Potential soil instability in the area.
4. Facility in proximity of sensitive area (i.e., shoreline, wetland, and stream).
5. Phosphorus-targeting media.
6. Located under structure.

5. OTHER OPPORTUNITIES

5.1 LOW-IMPACT DEVELOPMENT PRACTICES

Low-impact development (LID) emphasizes using on-site natural features integrated with small-scale stormwater controls to manage stormwater. WSDOT may include some LID practices in the revised HRM since the SWMMWW also emphasizes them if practicable. There may be opportunity to implement some form of LID practices for stormwater runoff on portions of the project, including the following (Hinman, 2001):

- Maximizing retention of native vegetation
- Preserving native soils and restoring disturbed soils compacted during construction with compost and other amendments to restore infiltration capacity and plant growth.
- Retaining and incorporating topographic site features that promote infiltration and storage of stormwater
- Locating construction access roads away from critical areas and soils that can effectively infiltrate stormwater
- Reducing construction access road and pedestrian and bicycle trail widths where possible
- Using pervious surfaces (e.g., pervious pavement and gravel systems) to promote stormwater infiltration where possible, such as on the pedestrian and bicycle trails
- Using small, bioretention areas with vegetation to infiltrate roadside, such as in landscaped and roadside areas

5.2 INFILTRATION

Infiltration has not been assumed in initial stormwater conceptual design of the larger stormwater facilities. Portions of the project are located in outwash as described earlier. Infiltration is encouraged in these soils when conditions are favorable and room is available. Since there are existing detention ponds recently constructed in these areas, detention instead of infiltration was assumed here as well. However, further soils investigation of infiltration potential in areas where encouraged is warranted at proposed facility sites during later stages of design.

5.3 PRACTICABILITY AND REGIONAL MITIGATION

It is WSDOT policy at a minimum to mitigate runoff impacts so that downstream flood damage and/or serious water quality problems are not increased as a result of new road projects. However, it is not always feasible to provide suitable mitigation that fully mitigates all project impacts adjacent to a project site, particularly in a highly developed urban area such as the SR 520 corridor. Thus, mitigation within the wider basin may become more beneficial and costeffective. WSDOT is currently developing methods for assessing the practicability of onsite vs. regional stormwater mitigation that includes elements of infrastructure, geotechnical, hydraulic, environmental/health and cost/benefit limitations. Basin-level mitigation measures, such as flow augmentation, infiltration, regional detention, stream habitat enhancement, and riparian acquisition, can effectively offset and mitigate project impacts. As an example, the City of Bellevue is compiling a list of acquisition sites and habitat enhancement projects for Kelsey Creek.

The State of Washington has developed interagency policy guidance for evaluating aquatic mitigation approaches, including regional mitigation. In general, regional mitigation may be considered when it will provide equal or better biological and other functional values compared to traditional on-site, in-kind mitigation. In making regulatory decisions, the agencies are instructed to "consider whether the mitigation plan provides equal or better functions and values, compared to existing conditions, for the target resources and species…."

This report assumes stormwater facilities would be constructed onsite to mitigate roadway runoff. There may be portions of the project and larger stream basins that could benefit from using a practicability and regional approach instead of larger on-site facilities. This approach could be further investigated and considered as additional information is gathered.

6. REFERENCES

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3. Washington State Department of Transportation. Hydraulics Manual. January 1997.

4. Washington State Department of Transportation. Highway Runoff Manual. February 1995.

5. Washington State Department of Transportation. Endangered Species Act Stormwater Effects Guidance Instructional Letter 4020.02. February 25, 2002.

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Appendix A
Impervious Areas and Stormwater Volume Estimates

Table A.1 Treatment and Detention Facility Estimates (West Side)

Subbasin	Lake Union South	Lake Union North	Portage Bay West	Portage Bay East	Union Bay	Union Bay	Union Bay
Location No.	**LU-1**	**LU-2**	**PB-1**	**PB-2**	**UB-1**	**UB-3**	**UB-2**
Station back	226,000	?	500	1,900	4,500		6,500
Station ahead		236,000	1,900	4,500	6,500		12,100
Roadway length (feet)	10,000	?	1,400	2,600	2,000		5,600
Existing vault and pond volume (cubic feet)	0	0	0	0	0	0	0
Existing impervious area (acres)	26.7	19.7	3.4	7.7	5.5	0.0	9.5
Bike and pedestrian path (acres)	1.1	19.1	0.8	0.7	1.1		1.3
Estimated percent of subbasin tributary to facility	100%	100%	100%	100%	100%		100%
8-Lane Alternative							
Impervious area (acre)	30.1	20.7	7.1	11.0	15.9	2.0	21.8
Added impervious	13%	5%	110%	42%	191%		130%
Predetention treatment flow rate (cubic feet per second)	9.04	6.20	2.14	3.30	4.77	0.60	6.54
Postdetention treatment flow rate (cubic feet per second)	N/A	0.62	N/A	0.33	0.48	0.06	0.65
Postdetention media treatment vault area (square feet)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Basic treatment volume (cubic feet)	139,755	95,905	33,084	50,994	73,776	9,280	101,152
Level 2 detention volume (cubic feet)	0	0	0	0	0	0	0
Additional detention + basic treatment required (cubic feet)	139,755	95,905	33,084	50,994	73,776	9,280	101,152
Stormwater wetland and wet pond with detention depth	5	5	5	3	3	3	3
Area of detention with stormwater wetland and pond (square feet)	27,951	28,771	9,925	16,998	24,592	3,093	33,717
Detention and wet vault depth	6	6	5	5	5	4	5
Detention and wet vault width	80	80	40	40	40	20	40
Detention and wet vault length	291	200	165	255	369		506

Subbasin	Lake Union South	Lake Union North	Portage Bay West	Portage Bay East	Union Bay	Union Bay	Union Bay
Location No.	**LU-1**	**LU-2**	**PB-1**	**PB-2**	**UB-1**	**UB-3**	**UB-2**
6-Lane Alternative							
Impervious area (acre)	28.4	20.7	7.1	11.0	18.1	2.0	16.9
Added impervious	7%	5%	110%	42%	231%	#DIV/0!	78%
Predetention treatment flow rate (cubic feet per second)	8.53	6.20	2.14	3.30	5.43	0.60	5.07
Postdetention treatment flow rate (cubic feet per second)	N/A	0.62	N/A	0.33	0.54	0.06	0.51
Postdetention media treatment vault area (square feet)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Basic treatment volume (cubic feet)	131,978	95,905	33,084	50,994	83,984	9,280	78,416
Level 2 detention volume (cubic feet)	0	0	0	0	0	0	0
Additional detention + basic treatment required (cubic feet)	131,978	95,905	33,084	50,994	83,984	9,280	78,416
Area of detention with stormwater wetland and pond (square feet)	39,593	28,771	6,617	16,998	27,995	3,093	26,139
Detention and wet vault length	275	200	165	255	420	116	392
					`	`	
4-Lane Alternative							
Impervious area (acre)	26.7	19.7	5.6	8.8	15.8	2.0	12.9
Added impervious	0%	0%	66%	15%	188%		37%
Predetention treatment flow rate (cubic feet per second)			1.69	2.65	4.73	0.60	3.88
Postdetention treatment flow rate (cubic feet per second)			N/A	0.27	0.47	0.06	0.39
Postdetention media treatment vault area (square feet)			N/A	N/A	N/A	N/A	N/A
Basic treatment volume (cubic feet)			26,147	41,023	73,205	9,280	60,052
Level 2 detention volume (cubic feet)			0	0	0	0	0
Additional detention + basic treatment required (cubic feet)			26,147	41,023	73,205	9,280	60,052
Area of detention with stormwater wetland and pond (square feet)			5,229	13,674	24,402	3,093	20,017
Detention and wet vault length			131	205	366		300

Table A.2 Treatment and Detention Facility Estimates (East Side)

Subbasin	Fairweather Bay	Cozy Cove	Yarrow Creek West		Yarrow Creek East	West Kelsey Creek		Goff Creek	Valley Creek West			Valley Creek East		Sears Creek		Lake Sammamish	Sammamish River West	Sammamish River East		Bear Creek West	Bear Creek East
Location ID	**FB-1**	**CC-1**	**YC-1**	**YC-2**	**YC-3**	**KC-1**	**KC-2**	**GC-1**	**VC-1**	**VC-2**	**VC-3**	**VC-4**	**VC-5**	**SC-1**	**SC-2**	**LS-1**	**SR-1**	**SR-2**	**SR-3**	**BC-1**	**BC-2**
Station back	24,284	28,100	30,977		36,300	40,345		45,016		46,150		51,100		527,00		56,467	58,925	66,400		70,000	71,650
Station ahead	28,100	30,977	36,300		40,345	45,016		46,150		51,100		52,700		56,467		58,925	66,400	70,000		71,650	73600
Roadway length (feet)	3,816	2,877	5,323		4,045	4,671		1,134		4,950		1,600		3,767		2,458	7,475	3,600		1,650	1,950
Existing vault and pond volume (cubic feet)	0	0	0	0	0	0	36000	0	0			46,000		0	0	54,000	700,300	0	0	21,025	44,120
Existing impervious area (acre)	9.6	6.1	13.2		21.2	15.2		3.2		11.7		8.0		16.1		13.5	34.4	6.7		4.3	4.6
Bike and pedestrian path (acre)	1.1	0.8	0.7		1.1	1.3		1.4		1.4		0.4		1.0		0.7	2.1	3.3		1.0	0.0
Estimated percent of subbasin tributary to facility	100%	100%	25%	75%	100%	40%	60%	100%	50%	14%	50%	100%	50%	50%	50%	100%	100%	35%	65%	75%	100%
8-Lane Alternative																					
Impervious area (acre)	19.1	12.2	7.7	23.1	52.4	11.1	16.6	4.0	10.1	2.8	10.1	8.3	4.1	10.3	10.3	15.2	36.8	4.7	8.7	6.2	5.7
Added impervious	99%	100%	133%		147%	82%		25%		97%		54%		27%		13%	7%	99%		43%	23%
Predetention treatment flow rate (cubic feet per second)	5.74	3.67	2.31	6.93	15.72	3.32	4.97	1.20	3.02	0.85	3.02	2.48	1.24	3.08	3.08	4.57	11.05	1.41	2.62	1.85	1.71
Postdetention treatment flow rate (cubic feet)	N/A	N/A	0.23	0.69	1.57	0.33	0.50	0.12	0.30	0.08	0.30	0.25	0.12	0.31	0.31	0.46	1.11	0.14	0.26	0.19	0.17
Postdetention media treatment vault area (square feet)	N/A	N/A	49	147	333	70	106	25	64	18	64	53	26	65	65	970	234	30	56	39	36
Basic treatment volume (cubic feet)	88,748	56,699	35,752	107,257	243,075	51,286	76,929	18,504	46,752	0	46,752	38,318	19,159	47,578	47,578	7,924	170,932	21,848	40,574	28,630	26,402
Level 2 detention volume (cubic feet)	0	0	136,305	408,916	926,722	195,527	293,290	70,546	178,240	49,907	178,240	146,086	73,043	181,392	181,392	17,419	0	0	0	109,154	100,658
Additional detention + basic treatment required (cubic feet)	88,748	56,699	172,058	516,173	1,169,796	246,813	334,219	89,049	224,992	49,907	224,992	138,404	92,202	228,970	228,970	25,344	170,932	21,848	40,574	116,759	82,940
Stormwater wetland and wet pond with detention depth	4.5	6.0	6.0	5.5	5.0	6.0	6.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0	5.5	3.0	4.0	4.0	5.0	5.0
Area of detention with stormwater wetland and pond (square feet)	19,722	14,175	43,014	93,850	350,939	61,703	83,555	26,715	44,998	14,972	44,998	34,601	23,050	57,243	57,243	6,912	56,977	8,193	15,215	23,352	16,588
Detention and wet vault depth	5.0	6.0	7.0	6.0	5.0	6.0	6.0	6.0	6.0	7.0	7.0	6.0	6.0	6.0	6.0	5.5	6.0	4.0	4.0	5.0	5.0
Detention and wet vault width	30	30	45	30	50	50	90	40	30	20	30	30	30	30	30	50	30	30	30	60	60
Detention and wet vault length	592	315	546	2,868	4,679	823	619	371	1,250	356	1071	769	512	1,272	1,272	92	950	182	338	389	276

Subbasin	Fairweather Bay	Cozy Cove	Yarrow Creek West		Yarrow Creek East	West Kelsey Creek		Goff Creek	Valley Creek West			Valley Creek East		Sears Creek		Lake Sammamish	Sammamish River West	Sammamish River East		Bear Creek West	Bear Creek East
Location ID	**FB-1**	**CC-1**	**YC-1**	**YC-2**	**YC-3**	**KC-1**	**KC-2**	**GC-1**	**VC-1**	**VC-2**	**VC-3**	**VC-4**	**VC-5**	**SC-1**	**SC-2**	**LS-1**	**SR-1**	**SR-2**	**SR-3**	**BC-1**	**BC-2**
6-Lane Alternative																					
Impervious area (acre)	16.9	10.6	7.0	20.9	50.2	10.0	15.0	3.3	7.2	2.0	7.2	8.0	4.0	8.9	8.9	13.5	34.4	4.7	8.7	6.2	7.7
Added impervious	76%	74%	111%		137%	65%		2%		41%		50%		11%		0%	0%	99%		43%	68%
Predetention treatment flow rate (cubic feet per second)	5.08	3.19	2.09	6.27	15.05	3.01	4.51	0.98	2.17	0.61	2.17	2.41		2.68	2.68			1.41	2.62	1.85	2.32
Postdetention treatment flow rate (cubic feet)	N/A	N/A	0.21	0.63	1.50	0.30	0.45	0.10	0.22	0.06	0.22	0.24		0.27	0.27			0.14	0.26	0.19	0.23
Postdetention media treatment vault area (square feet)	0.00	0	44	133	319	64	96	21	46	13	46	51		57	57			30	56	39	49
Basic treatment volume (cubic feet)	78,579	49,344	32,350	97,051	232,734	46,509	69,764	15,188	33,497	9,379	33,497	37,238		41,413	41,413			21,848	40,574	28,630	35,946
Level 2 detention volume (cubic feet)	0	0	123,335	370,006	887,297	177,316	265,975	57,904	127,707	35,758	127,707	141,971		157,888	157,888			0	0	109,154	137,042
Additional detention + basic treatment required (cubic feet)	78,579	49,344	155,685	467,056	1,120,030	187,826	335,739	73,092	161,204	451,37	161,204	133,209		199,301	199,301			21,848	40,574	116,759	128,868
Area of detention with stormwater wetland and pond (square feet)	17,462	12,336	38,921	84,919	33,6009	46,956	83,935	21,928	32,241	13,541	32,241			49,825	49,825			8,193	15,215	23,352	25,774
Detention and wet vault length	524	274	494	2,595	4,480	626	622	305	896	322	768			1,107	1,107			182	338	389	430
4-Lane Alternative																					
Impervious area (acre)	13.1	7.3	4.7	14.2																	
Added impervious	36%	19%	43%																		
Predetention treatment flow rate (cubic feet per second)	3.93	2.18	1.42	4.25																	
Postdetention treatment flow rate (cubic feet)	0.39	N/A	0.14	0.42																	
Postdetention media treatment vault area (square feet)	0.00	0	0	0																	
Basic treatment volume (cubic feet)	60,718	33,670	21,900	65,700																	
Level 2 detention volume (cubic feet)	0	0	83,494	250,481																	
Additional detention + basic treatment required (cubic feet)	60,718	33,670	105,394	316,181																	
Area of detention with stormwater wetland and pond (square feet)	13,493	8,418	26,348	57,487																	
Detention and wet vault length	405	187	335	1757																	

Appendix B
Roadway Drawings and Stormwater Facility Locations